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(6) BEHAVIOR CHARACTERISTICS OF TYPE I (75/25) OCTOL DURING MELT POURING HE WARHEAD M250 (CHAPARRAL).

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HMX	Analyses
TNT	Viscosity data
Processing characteristics	Particle size distribution

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A study was made of the characteristics of type 1 (75/25) octol during melt pouring for HE Warhead M250 (Chaparral). The parameters involved analytical, viscosity, and particle size distribution data.

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INTRODUCTION

A study was undertaken relative to the melt-pour of type 1 (75/25) octol, for the Chaparral warhead. It was desired to pinpoint and correct cavitation defects (which occurred periodically) by means of an examination of operations and lot characteristics.

PROCESS

Type 1 (75/25) octol is charged into a melt kettle and the melt temperature is raised to a minimum of 87.8°C (190°F). Upon the melting of the octol, HMX is suspended in molten TNT. Calcium silicate (ref. 1) amounting to 0.4% of the batch weight is next added to the explosive in the kettle. The temperature is then increased to 90.6°C (195°F) and a vacuum ranging from 635.0 to 660.4 mm (25 to 26 in.) is applied to the vessel for 30 minutes.

Warheads positioned on a rack in a buggy, each fitted with a loading former-funnel and each previously preheated to 81.1°C (178°F), are wheeled under the kettle to receive the product. A short hose equipped with pinch valve and attached to the outlet valve of the vessel reaches every warhead in the rack. With both valves open, an operator guides the flow of the explosive to each warhead by manipulating the pinch valve on the hose.

After loading is completed, the buggy of loaded warheads is transferred to the cooling bay. The rack controls the height and location of each warhead so that the loading funnels are centrally positioned between the heated panels in the bay.

For a minimum of 4 hours, as the warheads cool, heat is maintained on the panels surrounding the funnels. At the end of the 4-hour period, the heat to the panels is turned off and the warheads are allowed to cool completely.

Upon completion of cooling, the warheads are forwarded to subsequent operations. These involve drilling, cleaning of threads in the warhead, weighing of the loaded warhead, assembly of component parts, x-ray, inspection, painting, marking, and pack-out.

When cavitations occur in the warhead, as determined by the x-ray examination, the warhead is returned for disassembly, deep drilling of the cavity, and repour with the molten explosive.

OPERATING PARAMETERS

In order to maintain strict control of the process and minimize operating variables, the following parameters were used in most instances (also, see table 1).

Kettle size: 0.28 m^3 (75 gal.)

Batch size: 190.5 kg (420 lb)(approx.)

Mix cycle time:

Melt cycle: 60 min
Vacuum cycle: 30 min

Mix temperature: 87.8 to 93.3°C (190 to 200°F)

Kettle agitator speed:

Mix cycle: 40 ± 5 RPM
Melt-pour cycle: 15 to 20 RPM

Vacuum: 584.2 to 660.4 mm (23 to 26 in.)

Kettle outlet valve temperature (oil heated): 93.3 to 96.1°C (200 to 205°F)

Heat transfer fluid temperature (for oil heated panels): 121.1°C (250°F) (approx.)

RESULTS AND DISCUSSION

The lots used were procured from the Holston Army Ammunition Plant (AAP)(vendor) Kingsport, Tennessee, and complied in all respects with military specification for chemical and physical properties of octol (ref. 2) (tables 2 and 3). This specification states that type 1 (75/25) octol shall consist of grade B HMX (98% minimum purity) and that 100% of the HMX shall pass through a No. 8 US standard sieve. There are no additional granulation requirements. A blend of grade A and grade B HMX may be used provided that the mathematical weighted average of the blend's purity is 98 percent minimum. The TNT used shall conform to the military specification for type 1 (ref. 3). The TNT in current use is in flake form.

The relationship of warhead rejects to viscosity and to particle size distribution of HMX was examined (tables 4 and 5). Lots with a viscosity efflux value under 11 seconds in most cases gave the fewest rejects. Regarding particle size distribution of HMX, variations existed within the same lot. However, material with coarser sized particles of HMX, on a lot-to-lot basis, generally produced the fewest rejects. Although both ARRADCOM and the vendor used the military specification (ref. 5) method, there is no correlation between the ARRADCOM lab assay values for viscosity efflux data and that of the vendor.

The Naval Weapons Center, China Lake, California, has performed work relative to HMX compositions with binder (ref 4). In the development of these compositions, it became apparent that the physical characteristics of the HMX filler--specifically, particle size distribution--were of extreme importance relative to maximum solids loading and freedom from voids. Of many distributions tried, a tetramodal distribution high in class D (class 4) HMX, with lesser peaks at 200, 30, and about 7 microns, gave the best overall results. Specification requirements (ref. 5) for class D (class 4) HMX granulation are:

US standard sieve number	Class D (class 4) HMX (percent through sieve)
8	100
12	85 (min)
35	10 to 40
50	--
100	15 (max)
120	--
200	--
325	--

CONCLUSIONS

On the basis of the data presented the use of low viscosity octol, linked with coarser granulation characteristics of HMX, should optimize the melt-pouring phase of operations for Chaparral and should assure end item loading success.

RECOMMENDATIONS

Trial batches of type 1 (75/25) octol should be procured from Holston AAP with the following features:

1. Viscosity efflux value of 10.5 seconds maximum, instead of 15 seconds maximum as specified by reference 2.

2. Particle size distribution high in class D (class 4) HMX granulation as specified by reference 4 but having coarser granulation characteristics.

Feasibility studies should then be conducted evaluating process and product behavior relevant to the melt pouring of the warhead.[1] The studies should also include economic and capacity impact analyses on the part of Holston AAP to produce low viscosity octol[2] with granulation features as described.

REFERENCES

1. Military Specification, Calcium Silicate, Technical, MIL-C-51077, Amendment 2, dated 2 October 1969.

2. Military Specification, Octol, MIL-O-45445B, Amendment 1, dated 14 March 1977.

3. Military Specification, Trinitrotoluene (TNT), MIL-T-248C, Interim Amendment 1, dated 30 March 1976.

4. B. W. Stott and L. E. Koch, "Optimization of Filler Size Distribution for Preparing Castable Plastic Bonded Explosives," NWC Report 5216, China Lake, CA, May 1972.

5. Military Specification, HMX, MIL-H-45444B, Amendment 2, dated 12 July 1977.

6. Military Specification, Warhead, Guided Missile, HE, M250, Loading, Assembly, and Packing, MIL-W-50848C, Amendment 2, dated 10 July 1978.

[1]The cost of renovating a rejected warhead amount to about $300.

[2]The current type 1 (75/25) in use costs $4.45 per pound.

Table 1. Processing conditions.

Date of processing 1978	Lot	Temperature, °C (°F) Kettle outlet valve	Heat transfer fluid	During mixing cycle	During melt-pour cycle	Batch weight kg	Batch weight lb	Kettle agitator speed rpm	Vacuum mm (in.)	Viscosity efflux[a] sec	Series[b]	Warheads loaded	Rejects[c]
7/20	HOL-204	93.3 (200)	115.6 (240)	90.6 (195)	90.6 (195)	81.6 113.4[d] 195.0	180 250[d] 430	35	584.2 (23)	--	1 2	18 14	3 5
7/21	HOL-204	93.3 (200)	115.6 (240)	93.3 (200)	91.7 (197)	43.1 57.6[d] 100.7	95 127 222	44	584.2 (23)	--	1	16	3
8/7	HOL-199	--	--	--	--	190.5	420	--	--	--	1 2	18 18	3 1
8/8	HOL-199	--	--	88.9 (192)	88.9 (192)	190.5	420	42	584.2 (23)	--	1	18	3
8/9	HOL-3187	--	--	93.3 (200)	91.7 (197)	190.5	420	44	584.2 (23)	--	1 2	18 10	1 1
8/14	HOL-3187	--	--	93.3 (200)	91.1 (195)	190.5	420	34	584.2 (23)	--	1 2	18 18	0 0
8/15	HOL-205[e]	--	--	93.3 (200)	91.7 (197)	190.5	420	39	584.2 (23)	--	1 2	18 18	0 1
8/16	HOL-205[f]	--	--	91.1 (196)	90.6 (195)	108.9 40.8[d] 149.7	240 90[d] 330	35	609.6 (24)	--	--	--	--

[a] See footnotes at end of table.

Table 1. (Continued)

Date of processing	Lot	Temperature, °C (°F)				Batch weight		Kettle agitator speed rpm	Vacuum mm (in.)	Viscosity efflux[a] sec	Series[b]	Warheads loaded	Rejects[c]
		Kettle outlet valve	Heat transfer fluid	During mixing cycle	During melt-pour cycle	kg	lb						
8/19	HOL-315	--	--	100 (212)	93.3 (200)	190.5	420	40	635.0 (25)	--	1	18	0
											2	18	0
8/21	HOL-315	--	--	100 (212)	93.3 (200)	190.5	420	41	635.0 (25)	--	1	18	1
						22.7[d]	50[d]				2	18	0
						213.2	470						
8/22	HOL-315	--	--	91.1 (196)	91.1 (196)	163.3	360	40	635.0 (25)	--	1	18	2
						27.2[d]	60[d]				2	16	2
						190.5	420						
8/23	HOL-315-HOL 323	--	--	93.3 (200)	91.7 (197)	81.7 (315)	180 (315)	39	609.6 (24)	18	1	19	2
						81.7 (323)	180 (323)				2	19	0
						27.2 (315)[d]	60 (315)[d]						
						190.6	420						
8/28	HOL-323[g]	--	--	94.4 (202)	90.6 (195)	163.3	360	39	355.6 (14)	10	1	18	8
						27.2[d]	60[d]				2	18	0
						190.5	420						
8/30	HOL-323-310	--	--	95.6 (204)	92.2 (198)	108.9 (323)	240 (323)	39	609.6 (24)	13	1	18	
						81.7 (310)	180 (310)				2	18	
						27.2 (323)[d]	60 (323)[d]						
						217.8	480						

See footnotes at end of table.

Table 1. (Continued)

Date of processing	Lot	Temperature, °C (°F): Kettle outlet valve	Heat transfer fluid	During mixing cycle	During melt-pour cycle	Batch weight: kg	lb	Kettle agitator speed rpm	Vacuum mm (in.)	Viscosity efflux[a] sec	Series[b]	Warheads loaded	Rejects[c]
9/5 and 9/6	HOL-310-312-205[h]	--	--	93.3 (200)	91.1 (196)	27.2 (310) 108.9 (312) 27.2 (205) 40.8 (310)[d] 204.1	60 (310) 240 (312) 60 (205) 90 (310)[d] 450	39	685.8 (27)	12	1 2	18 18	18 18
10/2	HOL-311[i]	--	--	93.3 (200)	90.6 (195)	244.9	540	42	660.4 (26)	11	1 2	18 18	14 14
10/5	HOL-311[i]	93.3 (200)	123.3 (254)	93.3 (200)	90.6 (195)	217.7 40.8[d] 258.5	480 90[d] 570	42	660.4 (26)	11	1 2	18 18	7 16
10/11	HOL-311	93.3 (200)	123.3 (254)	93.3 (200)	91.7 (197)	54.4 54.4[d] 108.8	120 120[d] 240	40	635.0 (25)	11	1	14	2
10/17	HOL-311-312[i]	93.3 (200)	121.1 (250)	93.3 (200)	91.1 (196)	54.4 (311)[d] 136.1 (312) 190.5	120 (311)[d] 300 (312) 420	28	711.2 (28)	8	2	18	18

See footnotes at end of table.

Table 1. (Continued)

Date of processing	Lot	Temperature, °C (°F) Kettle outlet valve	Heat transfer fluid	During mixing cycle	During melt-pour cycle	Batch weight kg	Batch weight lb	Kettle agitator speed rpm	Vacuum mm (in.)	Viscosity efflux[a] sec	Series[b]	Warheads loaded	Rejects[c]
10/25	HOL-312	93.3 (200)	121.1 (250)	90.0 (194)	91.1 (196)	217.7	480	40	660.4 (26)	11	1	18	13
						20.4[d]	45[d]				2	18	4
						238.1	525						
11/2	HOL-312-320	93.3 (200)	121.1 (250)	90.0 (194)	90.0 (194)	27.2 (312)[d]	60 (312)[d]	42	660.4 (26)	7	1	18	2
						190.5 (320)	420 (320)				2	18	0
						217.7	480						
11/9	HOL-320	93.3 (200)	126.7 (260)	90.0 (194)	90.0 (194)	163.3	360	39	660.4 (26)	10	1	18	0
						54.4[d]	120[d]				1	18	0
						217.7	480						
11/21	HOL-320	93.3 (200)	126.7 (260)	90.0 (194)	90.0 (194)	163.3	360	50	685.8 (27)	7	1	18	0
						27.2[d]	60[d]				2	18	1
						190.5	420						
11/22	HOL-320	94.4 (202)	126.7 (260)	92.2 (198)	90.0 (194)	190.5	420	43	609.6 (24)	8	1	18	1
						26.3[d]	58[d]				2	18	1
						216.8	478						
11/27	HOL-316	93.3 (200)	128.9 (264)	90.0 (194)	91.1 (196)	27.2 (320)[d]	60 (320)[d]	44	660.4 (26)	17	1	18	3
						163.3 (316)	360 (316)				2	15	6
						190.5	420						

See footnotes at end of table.

Table 1. (Continued)

Date of processing	Lot	Temperature, °C (°F)				Batch weight		Kettle agitator speed rpm	Vacuum mm (in.)	Viscosity efflux[a] sec	Series[b]	Warheads loaded	Rejects[c]
		Kettle outlet valve	Heat transfer fluid	During mixing cycle	During melt-pour cycle	kg	lb						
12/6	HOL-316	93.3 (200)	126.7 (260)	91.1 (196)	90.0 (194)	163.3 27.2[d] 190.5	360 60[d] 420	45	584.2 (23)	17	1 2	18 18	1 0
12/7	HOL-316	93.3 (200)	132.2 (270)	91.1 (196)	92.2 (198)	163.3 27.2[d] 190.5	360 60[d] 420	50	584.2 (23)	25	1 2	18 18	0 0
12/8	HOL-316-308	93.3 (200)	126.7 (260)	91.1 (196)	90.6 (195)	81.7 (316) 54.4 (308) 27.2 (316)[d] 163.3	180 (316) 120 (308) 60 (316)[d] 360	45	584.2 (23)	14	1 2	18 10	1 1
12/13	HOL-308-313	92.2 (198)	126.7 (260)	90.0 (194)	91.1 (196)	108.9 (308) 54.4 (313) 27.2 (308)[d] 190.5	240 (308) 120 (313) 60 (308)[d] 420	45	584.2 (23)	9	1 2	18 18	0 1
12/14	HOL-313	--	--	--	--	163.3 27.2[d] 190.5	360 60[d] 420	--	--	10	1	18	0
12/15	HOL-313	93.3 (200)	128.9 (264)	91.1 (196)	91.7 (197)	108.9 18.1[d] 127.0	240 40[d] 280	49	609.6 (24)	9	1 2	18 6	0 0

See footnotes at end of table.

Table 1. (Continued)

Date of processing 1979	Lot	Temperature, °C (°F): Kettle outlet valve	Heat transfer fluid	During mixing cycle	During melt-pour cycle	Batch weight: kg	lb	Kettle agitator speed rpm	Vacuum mm (in.)	Viscosity efflux[a] sec	Series[b]	Warheads loaded	Rejects[c]
1/23	HOL-313	94.4 (202)	130 (266)	93.3 (200)	93.3 (200)	190.5	420	39	584.2 (23)	9	1 2	18 18	0 0
1/24	HOL-313-309	94.4 (202)	128.9 (264)	90.0 (194)	91.1 (196)	108.9 (313) 27.2[d] 81.6 (309) 217.7	240 (313) 60[d] 180 (309) 480	43	635.0 (25)	11	1 2	18 18	0 2
1/25	HOL-309	93.3 (200)	128.9 (264)	90.0 (194)	91.7 (197)	163.3 40.8[d] 204.1	360 90[d] 450	40	635.0 (25)	13	1 2	18 18	7 3
1/26	HOL-309	93.3 (200)	131.1 (268)	90.0 (194)	91.1 (196)	190.5 40.8[d] 231.3	420 90[d] 510	40	660.4 (26)	17	1 2	18 18	4 5
1/31	HOL-309	93.3 (200)	122.2 (252)	93.3 (200)	93.3 (200)	163.3 40.8[d] 204.1	360 90[d] 450	42	660.4 (26)	14	1 2	18 18	6 4
2/1	HOL-309	93.3 (200)	121.1 (250)	92.2 (198)	92.2 (198)	108.9 27.2[d] 136.1	240 60[d] 300	40	660.4 (26)	12	1	20	5

See footnotes at end of table.

Table 1. (Continued)

[a]The process control test for viscosity was determined at the point of operation in Bldg 810 using a viscosimeter cone preconditioned to a temperature of 60.0 to 76.7°C (140 to 170°F). The molten explosive was poured into the cone and its flow time (the time for the explosive to move from the tip of the upper marker to the tip of the lower marker) was recorded by stopwatch.

[b]Normally 18 warheads are loaded with octol at one time, constituting one series.

[c]Warheads are subject to radiographic examination for the defects listed below. The presence of one of the defects is cause for warhead rejection and its removal from the lot. (In most cases, warheads were rejected because radiographic examination revealed cavitation which exceeded specification requirements (ref. 6).)

1. Presence of a gap between the booster pellet and the S&A well bottom or between the booster pellet and the booster cup bottom where such a gap or the total of the gaps is greater than 1.52 mm (0.06 inch).

2. Cracked or delaminated booster pellet.

3. Explosive cast quality under the criteria for cavitation and porosity (ref. 6). (For cavitation, the total projected area of all cavities shall not be greater than 322.6 mm^2 (0.50 $inch^2$). The maximum dimension of a single cavity in the plane of observation shall not be greater than 9.7 mm (0.38 inch). For porosity, porous areas shall be treated as cavities, except that 80% of the projected length and 80% of the projected area shall be considered for acceptance purposes.)

[d]Scrap (defined as remelt explosive from a previous pour which is incorporated into a virgin batch).

[e]Initially this batch melt-poured with difficulty.

[f]Lack of material flow due to faulty diaphragm valve; this batch was discarded.

Table 1. (Continued)

[g] 150-gal. kettle used in place of 75-gal. kettle due to a faulty microswitch.

[h] An electrical failure occurred in the cooling bay, resulting in a temperature malfunction. Also, the oil tank which supplied energy to the heated panels began leaking and was repacked to eliminate leakage.

[i] Personnel new to the area and operations were assigned to the job.

Table 2. Analytical data - formulation and physical data

Date of processing (1978)	Lot	Source	HMX (%)	TNT (%)	Moisture (max)(%)	Insoluble particles on No. 60 (max)	Acetone insoluble matter (max)(%)	Viscosity efflux (sec)	Density at 25°C (77°F)
7/20	HOL-204	MIL-O-45445B requirements	75±2	25±2	0.25	5	0.10	15 (max)	--
		Incoming lot (virgin)							
		Vendor assay	76.7	23.3	0.14	passes	passes	14.8	--
		ARRADCOM lab assay	74.4	25.6	0.03	--	--	30.0	1.79
		Melt-pour process[a]							
		Initial	75.5	24.5	0.05	--	--	No flow	1.81
		Center	74.9	25.1	0.04	--	--	No flow	1.81
		End	73.0	27.0	0.03			100	1.80
7/21	HOL-204	Incoming lot (virgin)							
		Vendor assay	76.7	23.3	0.14	passes	passes	14.8	--
		ARRADCOM lab assay	74.4	25.6	0.03	--	--	30.0	1.79
		Melt-pour process[a]							
		Initial	74.5	25.5	0.03	--	--	65.0	1.79
		Center	74.1	25.9	0.05	--	--	110.0	1.78
		End	74.3	25.7	0.03	--	--	60.0	1.78
8/7	HOL-199	Incoming lot (virgin)							
		Vendor assay	74.5	25.5	0.18	passes	passes	12.5	--
		ARRADCOM lab assay	74.7	25.3	0.01	--	--	20.0	1.77
		Melt-pour process[a]							
		Initial	75.1	24.9	0.02	--	--	--	1.78
		Center	74.8	25.2	0.02	--	--	--	1.79
		End	74.9	25.1	0.02	--	--	--	1.77

See footnotes at end of table.

Table 2 (Continued)

Date of processing	Lot	Source	HMX (%)	TNT (%)	Moisture (max)(%)	Insoluble particles on No. 60 (max)	Acetone insoluble matter (max)(%)	Viscosity efflux (sec)	Density at 25°C (77°F)
8/9	HOL-3187	Incoming lot (virgin)							
		Vendor assay	--	--	--	--	--	--	--
		ARRADCOM lab assay	75.6	24.4	0.00	--	--	--	1.78
		Melt-pour process[a]							
		Initial	76.9	23.1	0.01	--	--	--	1.77
		Center	75.6	24.4	0.01	--	--	--	1.78
		End	75.4	24.6	0.02	--	--	--	1.78
8/14	HOL-3187	Incoming lot (virgin)							
		Vendor assay	--	--	--	--	--	--	--
		ARRADCOM lab assay	75.6	24.4	0.00	--	--	--	1.78
		Melt-pour process[a]							
		Initial	--	--	0.02	--	--	80.0	--
		Center	--	--	0.02	--	--	75.0	--
		End	--	--	0.02	--	--	92.0	--
8/15	HOL-205	Incoming lot (virgin)							
		Vendor assay	75.3	24.7	0.12	passes	passes	11.5	--
		ARRADCOM lab assay	75.50	24.50	0.03	--	--	27.0	1.78
		Melt-pour process[a]							
		Initial	76.32	23.68	0.03	--	--	80.0	1.79
		Center	75.38	24.62	0.03	--	--	90.0	1.80
		End	76.26	23.74	0.04	--	--	75.0	1.78

See footnotes at end of table.

Table 2 (Continued)

Date of processing	Lot	Source	HMX (%)	TNT (%)	Moisture (max)(%)	Insoluble particles on No. 60 (max)	Acetone insoluble matter (max)(%)	Viscosity efflux (sec)	Density at 25°C (77°F)
8/19	HOL-315	Incoming lot (virgin)							
		Vendor assay	74.4	25.6	0.09	passes	passes	9.7	--
		ARRADCOM lab assay	75.20	24.80	0.00	--	--	19.0	1.78
		Melt-pour process[a]							
		Initial	74.20	25.80	0.01	--	--	41.0	1.75
		Center	73.80	26.20	0.01	--	--	34.0	1.73
		End	76.40	23.60	0.02	--	--	63.0	1.78
8/21	HOL-315	Incoming lot (virgin)							
		Vendor assay	74.4	25.6	0.09	passes	passes	9.7	--
		ARRADCOM lab assay	--	--	--	--	--	--	--
		Melt-pour process[a]							
		Initial	--	--	0.02	--	--	41.5	--
		Center	--	--	0.02	--	--	45.0	--
		End	--	--	0.01	--	--	75.0	--
8/22	HOL-315	Incoming lot (virgin)							
		Vendor assay	74.4	25.6	0.09	passes	passes	9.7	--
		ARRADCOM lab assay	--	--	--	--	--	--	--
		Melt-pour process[a]							
		Initial	--	--	0.02	--	--	33.0	--
		Center	--	--	0.01	--	--	46.5	--
		End	--	--	0.02	--	--	62.5	--

See footnotes at end of table.

Table 2 (Continued)

Date of processing	Lot	Source	HMX (%)	TNT (%)	Moisture (max)(%)	Insoluble particles on No. 60 (max)	Acetone insoluble matter (max)(%)	Viscosity efflux (sec)	Density at 25°C (77°F)
8/23	HOL-315-323	Incoming lot (virgin)							
		Vendor assay	74.7	25.3	0.10	passes	passes	11.0	--
		ARRADCOM lab assay	--	--	--	--	--	--	--
		Melt-pour process[a]							
		Initial	--	--	0.02	--	--	49.0	--
		Center	--	--	0.02	--	--	35.0	--
		End	--	--	0.02	--	--	85.0	--
								18.0[b]	
8/28	HOL-323[c]	Incoming lot (virgin)							
		Vendor assay	74.7	25.3	0.10	passes	passes	11.0	--
		ARRADCOM lab assay	74.83	25.17	0.01	--	--	22.0	1.79
		Melt-pour process[a]							
		Initial	73.33	26.67	0.01	--	--	25.0	1.72
		Center	75.10	24.90	0.01	--	--	34.0	1.78
		End	76.11	23.89	0.01	--	--	No flow	1.73
								10.0[b]	

[a]The initial melt pour sampling procedure represents product used for loading warheads 1-12. The center melt-pour represents product used for loading warheads 13-24. The end melt pour represents product used for loading warheads 25-36. In most instances, 36 warheads are used in the loading procedure.

[b]Process control - cone method.

[c]Four reasons of economy, the ARRADCOM assay was cut off with Lot HOL-323.

Table 3. Analytical data - granulation of HMX (ARRADCOM lab assay).

Date of processing	Lot	Processing conditions	Particle size distribution of HMX[a] (% through mesh no.) 12	35	50	100	120	200	325	Series[b]	Warheads loaded	No. of rejects[c]	Lot percentage rejects
(1978)													
7/20	HOL-204[e]	Virgin	100	87.5	62.2	45.7	42.0	30.5	22.2				
		Initial	100	97.6	83.3	64.9	60.3	45.7	34.8				
		Center	100	99.4	88.9	69.3	64.2	47.3	35.1	1	18	3	
		End	100	94.4	73.5	53.5	48.7	35.3	27.0	2	14	5	25
		Mean[d]	100	97.1	81.9	62.6	57.7	42.8	32.3				
7/21	HOL-204[e]	Virgin	--	--	--	--	--	--	--				
		Initial	100	96.9	77.7	53.2	46.8	34.6	25.1				
		Center	100	91.1	68.2	47.9	43.7	30.9	22.3				
		End	100	93.7	69.5	48.0	44.0	30.8	23.3	1	16	3	18.8
		Mean[d]	100	93.9	71.8	49.7	44.8	32.1	23.6				
8/7	HOL-199[e]	Virgin	100	92.7	65.4	44.8	40.7	32.8	27.0				
		Initial	100	92.3	65.8	45.8	41.4	33.0	27.4				
		Center	100	94.0	65.9	45.4	41.3	33.4	27.7	1	18	3	16.7
		End	100	92.0	65.5	45.0	40.7	32.3	26.3				
		Mean[d]	100	92.8	65.7	45.4	41.1	32.9	27.1				
8/9	HOL-3187[e]	Virgin	100	80.4	59.9	39.0	33.8	22.7	16.3				
		Initial	100	86.1	61.4	40.6	35.1	25.6	19.6				
		Center	100	92.7	66.4	44.7	39.9	29.4	22.5	1	18	1	7.1
		End	100	87.5	63.8	42.9	38.6	28.5	22.2	2	10	1	
		Mean[d]	100	88.8	63.9	42.7	37.9	27.8	21.4				

See footnotes at end of table.

Table 3 (Continued)

Date of processing	Lot	Processing conditions	Particle size distribution of HMX[a] (% through mesh no.) 12	35	50	100	120	200	325	Series[b]	Warheads loaded	No. of rejects[c]	Lot percentage rejects
8/14	HOL-3187[e]	Virgin	--	--	--	--	--	--	--				
		Initial	100	89.9	66.5	44.6	39.2	27.4	19.6				
		Center	100	86.5	65.0	43.7	37.8	27.2	19.9	1	18	0	0
		End	100	95.2	79.0	53.1	46.4	33.5	24.3	2	18	0	
		Mean[d]	100	90.5	70.2	47.1	41.1	29.4	21.3				
8/15	HOL-205[e]	Virgin	100	72.8	50.1	34.0	30.0	22.9	17.5				
		Initial	100	94.4	66.8	44.4	39.6	29.4	23.6				
		Center	100	88.1	61.1	50.0	45.7	37.2	30.5	1	18	0	2.8
		End	100	91.9	63.1	42.2	38.7	30.1	24.0	2	18	1	
		Mean[d]	100	91.5	63.7	45.5	41.3	32.2	26.0				
8/19	HOL-315[e]	Virgin	100	82.6	60.7	43.8	39.1	29.4	23.0				
		Initial	100	95.0	73.1	52.0	46.8	35.2	27.4				
		Center	100	96.0	74.6	51.6	46.0	34.2	26.7	1	18	0	0
		End	100	91.2	69.3	48.1	43.3	31.4	23.5	2	18	0	
		Mean[d]	100	94.1	72.3	50.6	45.4	33.6	25.9				
8/21	HOL-315[e]	Virgin	--	--	--	--	--	--	--				
		Initial	100	87.7	67.4	49.5	44.4	33.5	26.6				
		Center	100	89.2	67.0	47.7	42.6	31.3	23.8	1	18	1	2.8
		End	100	85.2	63.5	45.6	41.0	30.3	23.4	2	18	0	
		Mean[d]	100	87.4	66.0	47.6	42.7	31.7	24.6				

See footnotes at end of table.

Table 3 (Continued)

Date of processing	Lot	Processing conditions	Particle size distribution of HMX[a] (% through mesh no.) 12	35	50	100	120	200	325	Series[b]	Warheads loaded	No. of rejects[c]	Lot percentage rejects
8/22	HOL-315[e]	Virgin	--	--	--	--	--	--	--				
		Initial	100	88.8	65.7	47.1	41.9	31.0	24.3				
		Center	100	88.4	66.7	48.0	43.3	31.8	24.7	1	18	2	11.8
		End	100	83.8	59.9	41.3	36.5	26.6	20.6	2	16	2	
		Mean[d]	100	87.0	64.1	45.5	40.6	29.8	23.2				
8/23	HOL-315-323[e]	Virgin	--	--	--	--	--	--	--				
		Initial	100	85.9	63.6	46.5	41.8	31.9	19.7				
		Center	100	89.8	64.2	47.6	43.2	33.2	25.7	1	18	2	5.6
		End	100	82.8	58.2	41.4	36.9	27.5	16.0	2	18	0	
		Mean[d]	100	86.2	62.0	45.2	40.6	30.9	20.5				
8/28	HOL-323[e]	Virgin	100	81.0	53.2	38.6	35.4	27.2	21.4				
		Initial	100	83.9	55.2	40.1	37.2	29.8	23.1				
		Center	100	86.9	51.9	32.2	26.5	19.4	13.7	1	18	8	22.2
		End	100	93.3	57.0	38.8	34.7	25.8	20.1	2	18	0	
		Mean[d]	100	88.0	54.7	37.0	33.5	25.0	19.0				

[a]Particle size distribution of HMX is determined by extracting the TNT from octol with suitable solvent. The remaining HMX is placed in an oven and dried at 100°C (212°F) for one hour. The material is then subjected to wet sieve procedure in accordance with the listed method in reference 5.

[b]See footnote b in table 1.

[c]See footnote c in table 1.

[d]Mean percentage values of initial, center, and end melt-pour.

[e]See *footnote a in table 2.*

Table 4. Viscosity efflux versus warhead rejects.

Date of processing	Lot*	Viscosity efflux, vendor assay (sec)	Warhead rejects (%)
1978			
7/20	HOL-204	14.8	25
7/21	HOL-204	14.8	18.8
8/7	HOL-199	12.5	16.7
8/15	HOL-205	11.5	2.8
8/19	HOL-315	9.7	0
8/21	HOL-315	9.7	2.8
8/22	HOL-315	9.7	11.8
8/23	HOL-315-323	9.7, 11.0 } 10.4 avg	5.6
8/30	HOL-323-310	11.0, 8.5 } 9.8 avg	0
11/2	HOL-312-320	8.0, 9.4 } 8.7 avg	5.6
11/9	HOL-320	9.4	0

*Lots in process where mechanical malfunction and/or unusual operating conditions occurred are not included.

Table 4. (Continued)

Date of processing	Lot*	Viscosity efflux, ven assay (sec)	Warhead rejects (%)
11/21	HOL-320	9.4	2.8
11/22	HOL-320	9.4	5.6
11/27	HOL-316	14.5	27.3
12/6	HOL-316	14.5	2.8
12/7	HOL-316	14.5	0
12/8	HOL-316	14.5	7.1
12/13	HOL-308 313	10.6 10.0 } 10.3 avg	2.8
12/14	HOL-313	10.0	0
12/15	HOL-313	10.0	0
1979			
1/23	HOL-313	10.0	6
1/24	HOL-313- 309	10.0 13.4 } 11.7 avg	5.6
1/25	HOL-309	13.4	27.8

*Lots in process where mechanical malfunction and/or unusual operating conditions occurred are not included.

Table 4. (Continued)

Date of processing	Lot*	Viscosity efflux, vendor assay (sec)	Warhead rejects (%)
1/26	HOL-309	13.4	25.0
1/31	HOL-309	13.4	27.8
2/1	HOL-309	13.4	25.0

*Lots in process where mechanical malfunction and/or unusual operating conditions occurred are not included.

Table 5. Particle size distribution of HMX versus warhead rejects.

Date of processing	Lot[a]	Particle size distribution of HMX - mean percentage values of initial, center, and end melt-pour (% through mesh no.)							Warhead rejects (%)
		12	35	50	100	120	200	325	
(1978)									
7/20	HOL-204	100	97.1	81.9	62.6	57.7	42.8	32.3	25.0
7/21	HOL-204	100	93.9	71.8	49.7	44.8	32.1	23.6	18.8
8/7	HOL-199	100	92.8	65.7	45.4	41.1	32.9	27.1	16.7
8/9	HOL-3187	100	88.8	63.9	42.7	37.9	27.8	21.4	7.1
8/14	HOL-3187	100	90.5	70.2	47.1	41.1	29.4	21.3	0
8/15	HOL-205	100	91.5	63.7	45.5	41.3	32.2	26.0	2.8
8/19	HOL-315	100	94.1	72.3	50.6	45.4	33.6	25.9	0
8/21	HOL-315	100	87.4	66.0	47.6	42.7	31.7	24.6	2.8
8/22	HOL-315	100	87.0	64.1	45.5	40.6	29.8	23.2	11.8
8/23	HOL-315-323[b]	100	86.2	62.0	45.2	40.6	30.9	20.5	5.6

[a]Lots in process where mechanical difficulties and/or unusual operating conditions occurred are not included.

[b]For economical reasons, the lab assay was cut off with lot HOL-323.

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Technical Report ARTSD-TR-79002

BEHAVIOR CHARACTERISTICS OF TYPE 1 (75/25)
OCTOL DURING MELT POURING HE WARHEAD
M250 (CHAPARRAL)

Herman J. Frigand

September 1979

The data called out in the ARRADCOM organizational block incorrectly identified the performing element. Attach new cover to the report that correctly reflects Technical Support Directorate as the performing element.

November 1979

AD

AD-E400 367

TECHNICAL REPORT ARTSD-TR-79002

BEHAVIOR CHARACTERISTICS OF TYPE I (75/25) OCTOL DURING MELT POURING HE WARHEAD M250 (CHAPARRAL)

HERMAN J. FRIGAND

SEPTEMBER 1979

US ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND
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